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United States Energy Policy: Security Not Independence

by

Lieutenant Colonel Blace C. Albert
United States Army

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USAWC STRATEGY RESEARCH PROJECT

United States Energy Policy: Security Not Independence

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Lieutenant Colonel Blace C. Albert
United States Army

Professor John F. Troxell
Center for Strategic Leadership
Project Adviser

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U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

Abstract

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This paper begins with a brief review of current U.S. energy policy as outlined in the White House's Blueprint for a Secure Energy Future and recent campaign speeches by President Obama. Energy choices are then described to highlight the lesser known implications associated with each one. The paper next addresses the evaluation criteria that should inform our national energy policy, something almost always neglected in policy proposals. These criteria include the ability to achieve energy security, the economic impact in the United States, and the environmental impact. Finally, the paper proposes a policy with the primary goal of achieving energy security. This is accomplished through the following objectives: 1) reducing the transportation sector's reliance on oil, 2) focusing on the most important energy sources, 3) preventing supply disruption, and 4) reducing demand.

United States Energy Policy:
Security Not Independence

Eight United States presidents, spanning over 40 years from President Nixon to President Obama, have called for energy independence.[1] This sounds great to the American voter due to the false assumption that energy would be cheaper than if purchased abroad. Energy independence is thought of as being able to consume only sources of energy produced in the United States. Doing so, however, would not consider what is best for protecting national interests and implementing security strategy. There is a distinct, but rarely understood difference, between U.S. energy security and energy independence. Energy policy should seek to achieve the former.

This paper begins with a brief review of current U.S. energy policy found in the White House's *Blueprint for a Secure Energy Future*. Energy choices are then described to highlight the lesser known implications associated with each one. The paper next addresses the evaluation criteria that should inform our national energy policy, something almost always neglected in policy proposals. These criteria include the ability to achieve energy security, the economic impact in the United States, and the environmental impact. Finally, the paper proposes a policy with the primary goal of achieving energy security. This is accomplished through the following objectives: reducing the transportation sector's reliance on oil; focusing on the most important energy sources; preventing supply disruption; and reducing demand.

First, it is necessary to define the critical term of energy security. Energy security means many different things to different people and organizations.[2] The best definition is offered in an American Security Project White Paper, which states that energy security is "the ability for a country to act in its foreign policy independently of how it

uses energy domestically."[3] This is a good definition because it elevates the importance of foreign policy, which in turn links to our national interests and security, as opposed to merely defining energy security as access to supply, protected infrastructure, resilient markets, or independence from other nations. A plan for energy security must actually be a plan for how energy policies will enhance national security.

Current Energy Policy

The "Blueprint for a Secure Energy Future" published in March of 2011, outlines the official energy policy for the United States.[4] One year later, the Deputy Assistant to the President for Energy and Climate Change, along with five cabinet secretaries and the Administrator for the Environmental Protection Agency (EPA), sent a letter to President Obama describing progress with respect to the *Blueprint*.[5] Throughout the 2012 presidential campaign, President Obama elaborated on, reinforced, and simplified the objectives of this policy in various speeches and debates.

The *Blueprint* is divided into three sections. The first section is "Develop and Secure America's Energy Supplies." Methods for accomplishing this include monitoring the safety of oil and gas development, providing incentives for timely production on leased land, ensuring fracking is done responsibly, and getting more natural gas and hybrid systems into U.S. mass transit. Internationally, the United States will help other countries move toward natural gas for electricity, help them take advantage of bioenergy, and create a framework for the safe development of nuclear power.[6]

The second main section of the *Blueprint* is "Provide Consumers with Choices to Reduce Costs and Save Energy." This section is heavily focused on conservation through increased efficiency in the vehicle fleet and more efficient homes and buildings. The United States will accomplish this with increased fuel economy standards,

continued biofuel development and use, and mass transit initiatives. A significant portion of the *Blueprint* then describes methods for improving efficiency of residential, commercial, and industrial buildings.[7]

The third main section of the *Blueprint* is "Innovate Our Way to a Clean Energy Future." The U.S. goal is to produce 80% of its electricity from clean energy sources by 2035 and by funding research and development (R&D) for new nuclear technologies. The United States will also eliminate fossil fuel subsidies and spend more to fund clean energy R&D. Finally, the federal government will lead by example with all new buildings being net-zero by 2020 and reducing petroleum usage by 30%.[8]

President Obama summarized his energy policy at the National Democratic Convention. The Administration's progress was described by the following: higher fuel standards that will double how far a car can go by the middle of the next decade, creation of thousands of renewable energy jobs, dropping oil imports by one million barrels per day (MBD) making America less dependent on foreign oil than at any time in the last two decades, and opening millions of acres for gas and oil exploration. President Obama indicated that fuel standards, renewable energy, declining oil imports, and domestic energy exploration will remain American priorities. He went on to list wind, solar, clean coal, and biofuels as sources of energy that America would continue to develop. There will also be efforts to build energy efficient buildings and develop a 100-year supply of natural gas from domestic resources. By doing this, the President is expecting to cut oil imports in half by 2020 and create 600,000 new jobs in natural gas.[9]

America's Energy Choices

This section provides information on the nine main sources of energy, their potential, and implications that are rarely mentioned by our national leadership when

espousing energy policy to the public. Table 1 lists advantages and disadvantages of each type of energy and may be referred to throughout this section of the paper.

Table 1. Advantages and Disadvantages of America's Energy Choices

Source	Advantages	Disadvantages
Oil[10]	-Extensive infrastructure -High energy/mass ratio -Easily transported liquid form -World not running out (> doubled proved reserves 1973 to 2008)	-Trans sector dependency -Impossible to control price (capital required to bring new resources to market, OPEC influence, foreign exchange rates affect value of dollar)
Coal[11]	-Large amount in U.S. -Well developed infrastructure -High energy/mass ratio	-High transportation costs -Environmental impact
NG[12]	-Large amount in U.S. -Well developed infrastructure -New tech allows more harvested with fewer environ disturbances -Can store underground	-Environ impacts of fracking unknown -uses large amount of water -potential for saline 'flowback' -potential to contaminate aquifers
Nuclear[13]	-No carbon dioxide/air pollutants -Can provide significant amount of U.S. energy consumption -Large amount of uranium available	-Radiation hazard -Spent fuel/high level waste disposal -High capital costs to start-up -Fukushima results slowing licensing
Hydro[14]	-Renewable and clean -Can operate 50-100 years	-Potential ecosystem damage -Tied to suitable water sources/most dams do not generate power -Tidal power may be unsuitable
Wind[15]	-Renewable and clean -Nothing emitted -Can build on land used for other purposes like crops	-Winds not constant or reliable -Impact to ecosystem -Unsightly addition to landscape
Solar[16]	-Renewable and clean -Minimal impact to environment -Energy conversion without bulky mechanical systems -Quickly installed/variety of sizes	-Sunlight not constant -Large surfaces required to collect -Efficiency (5-15%) -Manufacturing waste from toxic materials
Bio[17]	-Renewable -Ethanol can be added to gasoline -Burning municipal solid waste (MSW) reduces volume -Reduced combustion emissions	-Production competes with land that could produce food -Ecosystem impacts -2nd order effect on food prices
Geo[18]	-Renewable and clean	-Heat sources must be near surface -Many sources nationally protected

Oil

In 2011, the United States consumed 18.8 MBD of oil, 20% of the world's consumption, and 36% of energy used in the United States. 71% was consumed in the transportation sector.[19] Many do not understand that oil is considered a fungible commodity. This means the global market does not differentiate from where the oil comes. Prices are based on global demand. If the United States wanted to exercise economic power by not purchasing oil from state "x", the distribution of oil would merely adjust. The United States would get oil from state "y" instead, while state "x" would sell its oil to the country that was originally going to receive the state "y" oil. Achieving energy independence with respect to oil means that we would not have economic ties in particular areas. Sometimes this is a desirable application of the economic instrument of national power. Other times, however, the United States will want to maintain economic ties in a region. Energy security creates the freedom to choose.

Coal

Coal accounted for 20.2% of all energy used, and 46% of electricity generated, by the United States in 2011. 93% went toward electricity production with industrial uses consuming 6.7%.[20] There are three things important to understand about coal. First, the United States consumes a large amount and has vast resources available. The 1.1 billion short tons (BSTs) consumed in 2011 were equivalent to 3.8 billion barrels of oil. The 948 BSTs of worldwide recoverable reserves is equivalent to 3,270 billion barrels. The United States alone possesses 900 billion barrels of equivalent oil from its recoverable reserves of coal. This is more than 40 times the amount of proved oil reserves in the United States.[21] Second, environmental regulations are causing many coal-fired plants to close. It is possible that up to 25% will be retired by 2020 due to the

economic hardship of adhering to Environmental Protection Agency (EPA) regulations.[22] Finally, the price of coal is very dependent on the type companies are mining, the difficulty getting it out of the ground, distance to consumers, and the number of environmental regulations.[23] These are factors that the United States has more influence over compared to the fungible world petroleum market.

Natural Gas

Natural gas (NG) accounted for 25.6% of total energy used in the United States in 2011, almost 95% of which was produced domestically. The uses of NG are spread across several sectors: 33% industrial, 31% electricity, 19% residential, 13% commercial, and 3% transportation.[24] U.S. natural gas reserves possess great potential. Companies are discovering NG at a rate that makes it difficult to estimate how much exists. In 2009, there were 272.5 trillion cubic feet (TCF) of proved reserves. By 2010, the estimate was 318 TCF. In 2009, the total of undiscovered technically recoverable resources (UTRR) was estimated at 1,445 TCF, the equivalent of 256 billion barrels of oil. Additionally, the amount of NG from shale continues to rise as the United States determines how to drill safely. However, the impact of fracking on the environment is still uncertain. Fracking opponents believe that the impacts are known and are bad. Energy companies, on the other hand, claim they can develop the technology to protect the environment, but the regulatory controls implemented by the EPA must catch up.[25]

Nuclear

Nuclear fission accounted for 8.5% of energy consumed in the United States in 2011. All was used for electricity generation.[26] No other country in the world generates more electricity from nuclear power.[27] There are two important things to understand about nuclear energy. First, the Department of Energy (DOE) has yet to designate a

national storage site to accept spent nuclear fuel. Under President Obama, the Yucca Mountain Project in Nevada was terminated. The 1987 amendment to the 1982 nuclear Waste Policy Act authorized this site to be developed for just such a purpose. DOE was originally scheduled to accept waste in 1998, so they are now paying liabilities for waste delay that could total $11 billion. This also slows new construction, because licensing is based on the availability of a feasible disposal plan.[28] Second, the United States receives 86% of its uranium from foreign countries. Significant amounts come from Kazakhstan, Russia, Uzbekistan, Australia, and Canada, while the United States also imports from Namibia, Niger, Brazil, Czech Republic, South Africa, and six other countries.[29] The United States would have to invest significantly in its mining and milling infrastructure if it were to stop purchasing uranium worldwide.

The next five energy sources are considered renewable, and accounted for 9.4% of the total energy consumed in the United States in 2011.[30]

Hydropower

Hydropower accounted for 3.3% of energy consumed in the United States in 2011, of which 99.4% was used for electricity. Hydropower was 35% of total renewable energy consumed.[31] It is generated from turbines placed in rivers; however, it can also include tidal, wave, and thermal energy conversion. Tidal power is more predictable than wind or solar, but it requires at least a 10 foot tidal range to be economical. Wave power is rarely used, although there is potential for this technology on the west coast of the United States. Thermal energy conversion is not economically developed yet.[32]

Wind

Wind energy accounted for 1.2% of all the energy used in the United States in 2011. All of it went to electricity generation, but this was only 3% of the total electricity

consumed.[33] Wind energy accounted for 13% of all the renewable energy consumed by the United States in 2011.[34] To encourage wind energy growth, many electric companies offer a 'green pricing' option where customers may pay more for electricity produced by wind farms. This additional money furthers the development of wind technology. Many of these wind farms are privately owned by Independent Power Producers (IPPs) who sell their electricity to the power companies.[35]

Solar

Solar power was only 0.16% of all the energy used in the United States in 2011, and accounted for less than 2% of consumed renewable energy. The residential sector accounted for 89% of this. Solar power is produced through either photovoltaic (PV) cells that convert the energy directly to electricity or through solar thermal electric power plants that heat a fluid that drives a turbine to produce electricity.[36]

Biomass

Biomass accounted for 4.5% of total energy expenditure in the United States in 2011, which was 48% of all renewable energy consumed.[37] About half of the biomass was converted to fuel, mostly in the form of corn ethanol or biodiesel. In 2011, 13 billion gallons of ethanol were consumed as an additive to gasoline, 10% of the total 136 billion gallons of gasoline consumed.[38] Additionally, the United States consumed 878 million gallons of biodiesel made from oils that come from animal fats or vegetable plants like soybean or palm oil trees.[39]

There is an ongoing debate about the usefulness of biofuels. While those opposed focus on the disadvantages listed in Table 1, those in favor claim there is enough land for food and biofuel production, food-insecure countries are spending too much on oil, and bioenergy can help countries lacking modern energy increase the

amount of food they are producing. David Pimentel argues that 66% of the world is malnourished and starving, and the Congressional Budget Office estimates $6-9 billion more per year is spent on food due to corn ethanol production.[40] However, the World Hunger Education Service estimates that only 13.6% of the world is suffering from food scarcity.[41] When producing ethanol from corn, 46% more energy is expended than is in the final product, and it costs $3.97 to make a gallon. The United States uses fossil fuels to produce biofuel. Corn ethanol subsidies are greater than $6 billion per year; 60 times more per gallon than subsidies for gasoline. Subsidies for biodiesel are 74 times greater than diesel subsidies per volume.[42] The renewable fuel standard (RFS) requires the use of biofuels.[43] The Energy Independence and Security Act of 2007 stated a goal of 36 billion gallons of biofuel by 2022. Estimates indicate that if all corn produced in the United States was converted to ethanol, it would only account for 7% of oil consumption, and if all 235 million hectares of U.S. grasslands were used it would account for 12% of oil consumption. These are estimates, however, and it is difficult to predict the potential from genetic improvement or production chain management. Brazil, for example, produced 2,000 liters/hectare in 1975 and 7,000 liters/hectare in 2009.[44]

Geothermal

Geothermal energy accounted for only 0.23% of the total energy used in the United States in 2011 and 2% of the total renewable energy consumed. Of this, 72% was used to produce electricity.[45] What is rarely discussed is the practicality and efficiency of geothermal heat pumps which take advantage of the earth's subsurface being cooler than the air during the summer and warmer than the air during the winter. The U.S. Department of Energy and the Environmental Protection Agency have partnered with industry to promote the increased use of this readily available resource.[46]

Evaluation Criteria

Almost all experts, whether from academia, science and research, industry, or politics, fail to define the screening or evaluation criteria on which they are basing their assessments and recommendations concerning U.S. energy policy. Without criteria, one cannot get to the root of disagreements on energy policy. This paper evaluates the importance of energy sources based on six evaluation criteria that are grouped into three categories: energy security; economic impact; and environmental impact.[47] The energy policy proposed later will take into consideration the results of this analysis.

Energy Security

Recall that this paper defined energy security as the ability to separate how energy is used domestically from the execution of foreign policy. The two evaluation criteria used to assess contributions to energy security are sustainability and support to U.S. national security interests. Sustainability refers to how much of the energy source is available and accessible. It also considers infrastructure and the susceptibility to supply disruption. In addition, it must consider the amount of energy that may be harvested from the source on a per unit basis. For example, a pound of coal provides more energy than a pound of corn. Sustainability is the most important evaluation criterion, because if a source is not sustainable it becomes a screening criterion and the form of energy must be ruled as unfeasible.

Support to U.S. national security interests is primarily focused on the ability to gain influence in a region in order to promote and protect enduring national security interests globally. The National Security Strategy (NSS) references the need for the United States to remain globally engaged. It contains themes such as global leadership; comprehensive engagement; international order; peace, security, and opportunity

around the world; democracy and human rights abroad; strong alliances; and broad cooperation on key global challenges.[48] This is appropriate given the rise of globalism that is now increasing exponentially due to technology. The networks of worldwide interdependence make it extremely complex to promote and protect interests globally. According to Nye and Welch, “effects of events in one geographical area, or the economic or ecological dimension, can have profound effects in other geographical areas, on the military or social dimensions. These international networks are increasingly complex and their effects are therefore increasingly unpredictable.”[49] In light of this, the United States should work to build as many tools as possible that may be employed to promote or protect national interests. Increasing economic relations with a region does not just add another tool; it adds a tool that is very versatile. “Indeed, economic interdependence,” as Nye and Welch conclude, “can be more usable than force in some cases because it may have more subtle gradations.”[50]

Smart power is a relatively new term that refers to the combination of hard and soft power when formulating strategy. It has many advocates and also supports the premise that the United States should remain globally engaged. According to Nye, “The United States will need a smart power strategy and narrative that stress alliances, institutions, and networks that are responsive to the new context of a global information age.”[51] Many prominent American leaders agree with this statement. In 1994, Henry Kissinger stated that “an America that confines itself to the refinement of its domestic virtues would, in the end, abdicate America’s security and prosperity to decisions made by other societies in faraway places and over which America would progressively lose control.”[52] More recently, Admiral Mike Mullen, while chairman of the Joint Chiefs of

Staff, stated that when Secretary of State Hillary Clinton and Secretary of Defense Robert Gates called for “more funding and more emphasis on our soft power…I could not agree with them more.”[53] From Kissinger to Clinton, across theories of hard, soft, or smart power, there are many advocates for remaining globally engaged, and energy provides a means to do so.

In 1973, Arab states placed an embargo on oil sales to countries friendly to Israel. In the end, this conflict was resolved peacefully thanks to economic interdependence. Saudi Arabia had too many business investments in the United States. They would hurt their own economic interests if they hurt the U.S. economy too much. Saudi Arabia was also dependent on the United States for security.[54] This is an example of how important it is to maintain influence in various regions where national interests are at stake. The magnitude, diversity of locations, and projected growth of energy markets make them an obvious choice to use as a flexible means of implementing strategy. Energy security, not energy independence, provides the freedom to decide where to employ energy as a means of implementing strategy. Support to U.S. national security interests is therefore the second most important evaluation criterion.

Economic Impact

The evaluation criteria included under economic impact are consumer cost and U.S. job production. Consumer cost includes the price of energy such as electricity and gasoline; however, it also includes costs reflected in manufactured goods, other commodities, and higher taxes due to government subsidies paid to the energy sector. This is the third most important evaluation criterion. The fourth most important is U.S. job production. This criterion considers the number of people that can be employed as a

direct or indirect result of pursuing a particular energy source. It must also consider the duration of employment.

Environmental Impact

Environmental impact includes the criteria of minimizing harm to the environment and cost of environmental compliance. Minimizing harm addresses emissions contributing to acid rain and smog, greenhouse gases, and effect on ecosystems. It considers quantity of emissions and environmental impacts through the entire life cycle of the energy source. The cost of environmental compliance encompasses technologies that must currently be employed and those that are expected to go into effect in the future. This criterion is more subjective than the others due to the assumptions that one must make, including how significant emissions are to the environment and how severe environmental regulations will be in the future. Minimizing harm to the environment and cost of compliance are considered fifth and sixth most important respectively.

Importance of Energy Sources

The first step to proposing an energy policy is to use the evaluation criteria described above to prioritize sources of energy. The below criteria are listed in the same order discussed above, which is in their order of importance.

Energy Security: Sustainability

Hydropower, wind, solar, biomass, and geothermal are considered renewable forms of energy, because they can be sustained indefinitely. The definition of sustainability used here, however, considers the availability and amount of energy that can be extracted from the source. The United States is operating at about 25% of total potential with respect to hydropower despite this source only being a little more than 3% of the amount consumed.[55] Wind and solar are inconsistent (susceptible to disruption)

based on weather patterns, and they are highly geo-dependent. Biomass is limited by the area available to grow fuels and heat content. Geothermal heat pumps are a very sustainable source of heating and cooling in the residential and commercial sectors.

It is unknown how much uranium exists, but a safe estimate is that the United States could procure enough uranium for a couple hundred years at current nuclear consumption. Oil reserves doubled between 1973 and 2008, and the world's proved reserves could power the United States, China, and Japan for 107 years at the current rate of consumption. The UTRRs are at least five times greater. There is enough coal at existing mines in the United States for 260 years of current consumption, with estimated reserves totaling 4,000 years. NG UTTRs in the United States would last more than 60 years at current consumption, despite having only about 4% of the world reserves. Additionally, horizontal drilling and fracking technologies are increasing reserves so quickly it is hard to tell how much is truly available.

Considering all of the above, from a sustainability perspective, the energy sources are assessed in order of importance as follows: coal, natural gas, nuclear, oil, hydropower, geothermal, biomass, wind, and solar.

Energy Security: Support to U.S. National Security Interests

This criterion is heavily grounded in the number of interactions the United States has with other countries. The amount of importing and exporting weights the various interactions. Oil is a very important global market. Saudi Arabia, Russia, the United States, Iran, and China are all top producers, and Canada, Saudi Arabia, Venezuela, Nigeria, and Mexico are the largest suppliers to the United States. About 10% of coal was traded with most imports coming from South America and most exports going to Europe. The United States imported liquid natural gas (LNG) from Egypt, Qatar, and

Yemen, and exported to Canada and Mexico, although these are relatively small quantities. The largest NG reserves outside of the United States are in Russia, Iran, Qatar, and Saudi Arabia. The United States imported uranium from 16 different countries. Working with other nations in the nuclear field is also very important for creating transparency to ensure Nuclear Non-Proliferation Treaty (NPT) compliance. The five renewable sources provide much less opportunity to interact with other nations. Exporting technology would have a minimal effect. The one renewable that has some potential is biomass, because processed biofuel or biodiesel could be exported or imported.

Taking the above evaluation criterion and data into consideration, and placing additional emphasis on particular countries where U.S. interests are most vital, the importance of energy sources are listed in order as follows: oil, natural gas, nuclear, coal, biomass, hydropower, wind, solar, and geothermal.

Economic Impact: Consumer Cost

The following data uses conversion factors from the U.S. Energy Information Administration website.[56] The cost comparison is done relative to the British thermal unit (Btu) measure of energy using an average price. Oil costs 1.72 cents per thousand Btu.[57] Gasoline costs 2.82 cents per thousand Btu while corn ethanol costs 5.16 cents per thousand Btu.[58] Coal costs 0.30 cents per thousand Btu.[59] Electricity costs 2.93 cents per thousand Btu. NG costs 0.78 cents per thousand Btu.[60] The cost of nuclear energy is manifested as electricity except there are very high upfront capital costs for a new nuclear plant. This disadvantage is offset by the long lifespan of a nuclear power plant. Hydropower is also manifested as electricity. Wind, solar, and biomass all have very high government subsidies to spur growth which is an economic burden handed

back to taxpayers. Geothermal also has relatively high capital costs. Electricity and gasoline (end products) are relatively similar and much more expensive than the pre-manufactured sources. Ethanol is much more than gasoline, however. The highly subsidized renewables result in more expensive power.

Based on this criterion, the importance of energy sources is listed in order as follows: coal, natural gas, oil, hydropower, geothermal, nuclear, wind, solar, and biomass.

Economic Impact: U.S. Job Production

Calculating the number of jobs produced by each energy source, to include indirect and induced jobs, is not precise. Relative comparisons can be made, however. Between oil and NG there are an estimated 9.2 million jobs with 6.4 million in oil and 2.8 million in NG. This is expected to grow by an additional 1.4 million by 2030 with 1.4 million being in NG alone by 2035.[61] Coal employs over 1.98 million.[62] Nuclear power employs about 3,500 to build a plant and 4-700 permanent jobs to run and maintain the plant. With 65 plants in the United States, this equates to about 36,000 permanent jobs.[63] Hydropower employs 250,000 with the potential to expand to somewhere between 500,000 and 1.4 million.[64] Wind currently employs about 85,000 but this is heavy on the manufacturing, construction, and transportation aspects. Only 5% of those employed work in operation and maintenance (permanent jobs).[65] Solar energy is responsible for 119,000 jobs but growth is about 13%.[66] Biomass employs about 470,000 people. Geothermal employs about 20,000.[67]

Based on the current number of jobs produced within each energy sector, and the magnitude of potential jobs that may be created, the energy sources are ranked in

order as follows: oil, natural gas, coal, hydropower, biomass, solar, nuclear, wind, and geothermal.

Environmental Impact: Minimizing Harm to the Environment

Coal is the worst in terms of emissions that include carbon dioxide (greenhouse gases), nitrogen oxide (smog), and sulfur dioxide (acid rain). There is also an impact to the environment and health implications due to mining. Oil is also bad due to emissions, particularly from engines that use the oil products such as gasoline and diesel. Natural gas is much cleaner. It produces over 40% less carbon dioxide than coal, for example. The environmental impact due to fracking is still undetermined. Nuclear energy is very clean, but has the concern of disposing the nuclear waste. The renewable sources all have a low impact to the environment. There is not an emissions problem except for the biofuels. They burn cleaner than petroleum based gasoline, but they have more smog producing evaporative emissions. The remaining sources only impact the ecosystem. Examples include fish migration considerations for hydropower, birds and bats being killed in wind turbine blades, and many of the U.S. geothermal reservoirs near the earth's surface being located in federally protected parks.

Based on this evaluation criterion, the fuel sources from best to worst are: geothermal, solar, hydropower, wind, nuclear, biomass, natural gas, oil, and coal.

Environmental Impact: Cost of Environmental Compliance

The current and pending regulations for coal make it the source of energy that is most costly to be environmentally compliant. It has been so expensive that many plants are opting to shut down rather than comply with environmental regulations.[68] The other fuel sector that suffers from environmental compliance is nuclear. The U.S. is paying exorbitant amounts of money in lawsuits, because permanent storage facilities for spent

nuclear fuel have yet to be identified and built. Oil and NG are next in line for costs of environmental compliance.

The sources of fuel for this evaluation criterion are therefore listed in order: geothermal, solar, hydropower, wind, biomass, natural gas, oil, nuclear, and coal.

Assigning a numerical value to the results of the above analysis, and then weighting the results based on the importance of each criterion, the relative importance of each fuel source is found. This is demonstrated in Table 2.

Table 2. Applying Evaluation Criteria to Determine Energy Importance

Criterion	Oil	Coal	Gas	Nuke	Hydro	Wind	Solar	Bio	Geo
Engy Security Sustain (x3.5)	3 10.5	4 14	3.8 13.3	3.6 12.6	2 7	1 3.5	0.8 2.8	1.6 5.6	1.8 6.3
Engy Security Interests (x3)	4 12	3 9	3.8 11.4	3.6 10.8	1 3	1.8 5.4	0.8 2.4	2 6	0.6 1.8
Economic Cost (x2.5)	3 7.5	4 10	3.8 9.5	1.6 4	2 5	1 2.5	0.8 2	0.6 1.5	1.8 4.5
Economic Jobs (x2)	4 8	2.8 5.6	3 6	1.4 2.8	2 4	1 2	1.6 3.2	1.8 3.6	0.8 1.6
Environment Harm (x1.5)	2 3	1 1.5	2.6 3.9	3 4.5	3.6 5.4	3.4 5.1	3.8 5.7	2.8 4.2	4 6
Environment Cost (x1)	1.8	0.8	2	1	3.6	3.4	3.8	3	4
Total	42.8	40.9	46.1	35.7	28	21.9	19.9	23.9	24.2

The amount of weighting to account for the relative importance of the criteria is shown in the first column. Looking at the first row, coal was most sustainable, so it received a 4. It was followed closely by NG and nuclear. Oil was next but there was a significant difference between nuclear and oil so it dropped all the way to a 3, and so on. All of these figures were multiplied by 3.5 to weight them with the most important criterion. The weighted figure is the second number in each box. The totaled results are shown in the bottom row. From the energy source that deserves the most consideration to the one that deserves the least, based on the evaluation criteria established above,

the results are as follows: natural gas, oil, coal, nuclear, hydropower, geothermal, biomass, wind, and solar. The below proposed energy policy considers these results.

Proposed Energy Policy

U.S. energy policy should have the primary goal of achieving energy security. In other words, decouple foreign policy and domestic energy consumption so the United States can use energy as a means of promoting national interests and implementing National Security Strategy objectives. The below recommended policy achieves energy security through the accomplishment of four objectives: reducing the transportation sector's reliance on oil; focusing on the most important energy sources; preventing supply disruption; and reducing demand.

Reduce the Transportation Sector's Reliance on Oil

The greatest threat to security comes when there is only one source of energy for a desired output. The U.S. economy and way of life depends upon gasoline consuming vehicles. OPEC chokes supply in order to increase the cost of a barrel of oil. In the last 10 years, the cost rose from $25 to over $100 based on whatever OPEC determined to be a 'fair' price. Meanwhile, the United States can do nothing but continue to purchase oil from the global market due to its reliance on oil for transportation.

There are three options for the United States to curb the transportation requirement for gasoline produced from oil. First, coal could be converted to liquid methanol. This method could be implemented the soonest, because the technology already exists and it would merely take inexpensive fuel sensors and noncorrosive fuel lines to modify cars to run with methanol as a gasoline additive. China is already blending 15% methanol in their fuel. The problem with this method is that the conversion technology is not environmentally friendly. Second, the United States could

invest in LNG powered vehicles. Gasoline is such an attractive fuel, because it is easy to transport in liquid form and has a high energy content. If an additional tank allowed the consumer to select between gasoline and LNG to use the cheaper fuel, the cost of oil would be driven down. The problem with this option is that it would take a very long time to infuse the market with this type of vehicle produced in an economically feasible way. The third way would be to move toward electric vehicles as the primary means of transportation. This would greatly reduce the amount of oil consumed since the United States uses very little oil to produce electricity.[69]

The United States should focus on this third option. Electrifying the transportation sector has several benefits. First, it accomplishes the main objective of reducing the transportation sector's reliance on oil. Industrial petroleum requirements would still create opportunities for interaction in regions where the United States needed to maintain influence, but the country could rely largely on domestic production if desired. Second, electricity generation occurs from many different energy sources. Therefore, by electrifying the transportation sector, the United States will also be facilitating the accomplishment of the second and third objectives of this policy described below. Finally, the electric vehicle market is much more mature than the other two options. The price of batteries is on the brink of falling significantly which will make electric cars more affordable. The United States needs to divert subsidies from less useful fuels like solar and wind and invest in the electrical generating and sustaining infrastructure that will be required to support large numbers of electric vehicles. New power plants should be multifunctional so they can switch between coal and natural gas, and existing plants need similar upgrades. The U.S. nuclear program needs to be reinvigorated with

existing subsidies diverted to the capital costs of nuclear plants. Smart grids must be implemented with a timeline for bringing existing facilities up to standard.

Focus on the Most Important Energy Sources

The second objective of this energy policy is focusing U.S. energy efforts around the importance of the energy sources as determined by the above evaluation criteria. First, the United States must invest seriously in the development of NG. The vast NG resources possessed by the United States thanks to new technologies, the number of people employed as a result of the NG industry, and the multiple uses of NG (especially for electricity) make this resource vital. Exploration and development must be encouraged by making NG prices competitive. Reducing oil dependence will do just that as oil prices drop. The United States needs to invest heavily in the infrastructure to support increased demand for NG. This is critical to ensure that increased supply is not hindered by infrastructure to transport, process, and utilize the resource. The increased demand will stimulate technology that makes more reserves technically recoverable and economically feasible. Federal fracking regulations can bring this about in a responsible manner that provides appropriate confidence while addressing environmental concerns.

Second, the United States must remain a key player in the global oil market. There are several reasons for this, which include the 5.5 MBD used by the United States for other than transportation, the amount of time it will take to transition to a primarily electric transportation sector, and the growth of other countries that would purchase the oil formerly bought by the United States. Reducing oil dependence does not mean that the United States will necessarily be less involved in the petroleum business. It might just mean that net exports increase. It will be important to continue trading globally to maintain influence in areas where the United States needs to protect

vital interests. Those areas will be numerous as long as our vital interests include stable international order, promotion of values, and economic prosperity.[70] Oil employs more people in the United States than any other source of energy. The United States must invest in the infrastructure that will be necessary to keep up with the increasing *global* demand for oil, even as domestic demand decreases.

Third, the United States cannot disregard its most abundant source of energy, and therefore must retain the ability to produce electricity from coal. This may be done in conjunction with natural gas and nuclear power, but environmental concerns for coal cannot prevent the country from achieving energy security. Power plants must have the flexibility to switch to coal. New plants must include scrubber technology and the federal government should invest in carbon sequestration technology. Existing plants must be made capable of using multiple fuel sources and environmental controls should be implemented. A reasonable timeline for these modifications is required. Causing coal fired plants to go out of business, because environmental compliance is not economically feasible, is unacceptable. A much slower timeline that gradually increases taxes on emissions would facilitate a proper transformation to cleaner coal technologies.

Fourth, the U.S. nuclear program needs to be reenergized. Nuclear power is a terrific way to generate electricity due to the amount that can be produced, the very low impact to the environment, and the quantities of uranium available. The government can stimulate nuclear growth by subsidizing the capital costs of building a plant and by determining how nuclear waste will be stored. Nuclear waste storage should become the responsibility of the states to prevent one state from storing all of the country's waste – a proposal that will almost certainly meet with resistance from the state that is

chosen. If a state does not want to store waste, it would have the option of paying another state to take their spent nuclear fuel. Continuing to develop and expand our nuclear technology and capability will help the United States remain engaged globally in nuclear programs which is very important for transparency and NPT enforcement.

Finally, the less important renewable sources of energy should be given an appropriately reduced amount of attention. Hydropower, geothermal, biomass, wind, and solar have a place in U.S. energy policy, but they will never produce enough energy to prevent the need to use NG, coal, and nuclear power. There will also always be a need for the industrial uses of NG, oil, and coal. Subsidies for biofuels should be stopped. Corn should be sold first for food and then at a lower cost for ethanol production. This will help ensure that food prices in poorer countries do not exceed their ability to purchase due to scarcity. Meanwhile, continuing to develop bioenergy using non-food sources is still constructive in the short term while the United States transitions to electric transportation. Wind and solar technologies can be exported for economic advantage. Helping countries with deserts deploy solar capabilities can be very beneficial to them, but solar and wind will not produce a significant amount of energy to cause the United States to move away from the fossil fuels and nuclear energy.

Prevent Supply Disruptions

The third objective of this policy is to ensure that supply disruption does not affect energy availability, making the United States execute foreign policy in an undesirable way. To ensure energy security, supply must be increased through a broad spectrum of methods. First, sources of a particular energy must be redundant. The United States must be able to produce or purchase oil or uranium, for example, from numerous locations. Even with regard to the energy sources like NG or coal that the United States

already possesses, the reserves and infrastructure must be redundant to ensure that an accident or terrorist attack cannot affect supply and distribution.

Second, energy source alternatives must exist to perform the same function. Therefore, electric power plants need to be built for coal and natural gas while smart grids integrate electricity from these plants, nuclear plants, and wind energy. The electric vehicle fleet and infrastructure powered by electricity will continue to operate seamlessly if a single energy supply is disrupted.

Third, the United States should build up reserves in order to absorb unforeseen events. For example, the United States was recently able to release oil from strategic reserves in order to counteract the rising oil prices caused by the Libyan conflict. This needs to be done with every energy source. The United States must continue to increase capacity to store NG, both underground and in manmade containers. Infrastructure should grow to create redundancy in storage and delivery. This would prevent price fluctuations caused by unexpected supply disruptions such as shutting down drilling in the Gulf of Mexico.

Fourth, the use of government subsidies needs to be reformed to put emphasis in the right areas. Oil and biofuel subsidies should be eliminated. Improving fracking technology should be encouraged by subsidizing natural gas extracted with this technique. The capital costs of nuclear plants should be subsidized to encourage nuclear growth. Generous tax exemptions should be offered for buildings that include geothermal and solar augmentation. A slow increase on taxation of greenhouse gasses can bring clean coal into the future of our electricity production. Most importantly, subsidies, taxes, and tax exemptions must instill confidence by being long term. The

current political maneuvering that puts subsidies in jeopardy from year to year is not helpful.

Fifth, the United States should continue to develop renewable energy in a reasonable manner. Wind will not produce enough power to prevent us from using fossil fuels and nuclear power, but in the spirit of preventing supply disruption, wind power should be placed at critical infrastructure nodes to augment and back up key facilities. All waste facilities should be built to harvest MSW energy. There is no downside to capturing this biogas and reducing the volume of waste while utilizing waste energy. Hydropower needs to grow where possible, once again creating redundancy. Wave power on the west coast should be part of this growth. Finally, tax exemptions should be used to encourage geothermal heat pumps and solar power on all new home construction. This myriad of methods greatly increases supply and provides the flexibility and redundancy to avoid supply disruption.

Reduce Demand

The fourth objective of this policy focuses on two different ways of decreasing demand. First, the United States must improve mass transit. This country is well behind many countries with respect to the availability and infrastructure of public transportation. Second, the United States should continue to develop conservation programs that reward efficiency with less expense. There should also be a renewed emphasis on capturing and reusing rejected energy, particularly from electricity generation.

Conclusion

Energy independence is not truly what Americans want, nor should it be the goal of our country's energy policy. The real goal should be energy security that would allow the United States to conduct foreign policy without regard to how energy is consumed

domestically. This proposed energy policy can accomplish the goal of energy security through the successful implementation of four objectives. First, reduce the transportation sector's reliance on oil by converting the majority of the country's vehicles to electric. Second, focus on the most important energy sources as determined by the application of clearly defined evaluation criteria. The emphasis for the United States should be on fossil fuels, nuclear power, and renewable energy respectively. Third, prevent supply disruption by implementing numerous ways of increasing supply. Also build energy resources and infrastructure to be flexible and redundant. Fourth, reduce demand by investing in mass transit and continuing to develop effective programs for rewarding efficiency. It is alright for President Obama to be the eighth president failing to achieve energy independence, but his *Blueprint* must evolve as this paper proposes in order to accomplish that which is vital to the preservation of national interests…energy security.

Endnotes

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